



# The Ballistic Missile Defense System

## ***Introduction***

In years since the end of the Cold War, the increased proliferation of ballistic missile systems and weapons of mass destruction has raised the importance of developing and fielding a capable Ballistic Missile Defense System (BMDS), as a number of potentially hostile countries have acquired these dangerous capabilities. In response to this changing geopolitical environment, the Department of Defense has made building a Ballistic Missile Defense System (BMDS) a priority. The fundamental goal of the planned BMDS is building a layered defense to defend the United States and its forces, territories, allies and friends.

The Missile Defense Agency (MDA)'s mission is to develop, test and prepare for fielding a missile defense system. Using complementary interceptors, land-, sea-air- and space-based sensors and battle management command and control systems, the planned missile defense system will be able to engage all classes and ranges of ballistic missile threats.

Our programmatic strategy is to develop, test and continuously evaluate production, fielding and operational alternatives for BMDS to provide reliable, effective defenses.

All ballistic missiles share a fundamental characteristic - they follow a trajectory, which includes three flight phases - boost, midcourse and terminal. By fielding a layered defense system and attacking the missile in all phases of flight, we exploit opportunities to increase the effectiveness of missile defenses and complicating an aggressor's plans.



## ***Layered Defenses***

MDA is developing and testing the elements of a BMDS capable of engaging all classes of ballistic missile threats. The program integrates Command, Control, Battle Management and Communications (C2BMC) elements into layered defense segments to engage threat targets in all phases of flights. MDA is developing and testing promising technologies including kinetic and directed energy (laser) platforms, radar and electro-optical sensors, and investigating land, sea, air and space basing options. Demonstrated capabilities will be fielded incrementally in "Capability Blocks" to provide near term defense and to increase system robustness to pace the growing threat.

## ***Block Approach***

MDA continues to pursue research, development, test and evaluation programs. MDA is working to put defenses into the field in two-year blocks, with successive blocks providing increasing levels of capability to counter all ballistic mission threats. A block is a biennial increment of the BMDS providing an integrated set of capabilities, which has been rigorously tested as part of the BMDS Test Bed and assessed to adequately characterize its military utility. The configuration for each block is drawn from the prior BMDS Block; BMDS elements, components, technologies, and concepts; Command, Control, Battle Management and Communications (C2BMC) architecture; and externally managed systems, elements or technologies. Each successive block provides increasing levels of capability to counter ballistic missiles of all ranges and complexity.

Once tested, elements and components are available for limited procurement, transition to production or for initial defensive operations as directed. These "off-ramps" may occur any time during the Block Cycle to support timely execution of these transition or fielding decisions. This allows the capability to get into the hands of our customer, the warfighter, at a faster rate than would otherwise be possible, while MDA continues future development. Deployment decisions are based on an assessment of system technology and operational effectiveness, status of threat, system cost and national security considerations.

## ***Test Bed and Initial Fielding***

Ground was broken at Fort Greely, Alaska, on June 15, 2002 for missile silos and support buildings for the Missile Defense Test Bed and allows for operationally realistic testing throughout most of the Pacific Ocean. The test bed will add realism to ground and sea-based midcourse testing by allowing multiple engagements, different trajectories and adding additional intercept areas. The test bed also includes boost and terminal segment tests, which will demonstrate the viability of the layered missile defense concept.

On December 17, 2002, President George W. Bush directed DoD to field initial missile defense capabilities beginning in 2004. The plan calls for up to 20 ground-based interceptors to be located at Fort Greely and Vandenberg Air Force Base, Calif., to defend against long-range ballistic missiles in 2004-2005. To defend against short-and medium-range missiles, up to 20 sea-based interceptors are planned to be operational on existing U. S. Navy Aegis ships by the end of 2005.

## ***Boost Phase***

The boost phase is the part of a missile's flight path from launch until it stops accelerating under its own power. Typically the boost phase ends at altitudes of 300 miles or less and within the first 60 to 300 seconds of flight. During this phase, the rocket is climbing against the Earth's gravity. Intercepting a missile in its boost phase is the ideal solution. We can defend a very large area of the globe and prevent midcourse decoys from being deployed. The Boost Defense Segment is designed to intercept threat missiles during this phase. The capabilities deployed in this segment will progressively reduce the safe havens available to a hostile state.

The potential boost defense elements are directed energy systems using high power lasers and kinetic energy systems (land- or sea-based interceptors) with high velocity interceptor capabilities. Air and sea based elements may reduce the size of safe havens, whereas development of viable space-based elements could potentially eliminate them entirely. Of this segment's elements, the Airborne Laser (ABL) is the most mature in its development.

Boost Defense System elements will be integrated into an overall Ballistic Missile Defense operational concept including those involving the Midcourse and Terminal Defense Segments. Sensors developed in this segment will have multi-mission capabilities intended to enhance and integrate detection of and provide critical tracking information for threat ballistic missiles in all phases of flight.

## ***Midcourse Phase***

The midcourse phase of a ballistic missile trajectory allows the largest window of opportunity to intercept an incoming missile. This is the point where the missile has stopped thrusting so it follows a more predictable glide path. The midcourse interceptor has a longer time to track and engage the target compared to boost and terminal interceptors. Also, more than one interceptor could be launched to ensure a successful hit. A downside to the larger intercept window is the attacker has an opportunity to deploy countermeasures against a defensive system. However, the interceptor also has more time to observe

and discriminate countermeasures from the warhead. The Midcourse Defense Segment has ground-and sea-based elements.

The primary elements of the Midcourse Defense Segment are the Ground-Based Midcourse Defense and Aegis Ballistic Missile Defense (Aegis BMD), the successors to the National Missile Defense and Navy Theater Wide programs. Aegis BMD is intended to intercept hostile missiles in the ascent and descent phase of mid-course flight, which when accompanied by the Ground-Based defenses, provides a complete midcourse layer defense. Sea-based elements also offer opportunities to engage missiles in early ascent, thereby reducing the overall BMD System's susceptibility to countermeasures. Aegis BMD builds upon technologies in the existing Aegis Weapons System now aboard U.S. Navy ships and the Standard Missile 3 infrastructures.

## ***Terminal Phase***

A missile enters the terminal phase when the warhead falls back into the atmosphere. This phase generally lasts less than a minute.

The primary elements in the Terminal Defense Segment are the Theater High Altitude Area Defense (THAAD) and the PATRIOT Advanced Capability-3 (PAC-3). PAC-3 is expected to transfer to the Army in 2003. MDA will still be responsible for PAC-3's integration into



BMDS. Two other terminal defense elements are the Arrow, a joint effort between the U.S. and Israel, and Medium Extended Air Defense System (MEADS), a co-developmental program with Germany and Italy. DoD is considering making future development of MEADS an Army-led effort because of its close association with PAC-3.

## ***Sensors***

An effective layered defense incorporates sensors to detect and track threat missiles through all phases of their trajectory. The restructured Space Tracking and Surveillance System (STSS) will develop a series of interoperable Research and Development (R&D) satellites and supporting ground infrastructure for the detection, tracking and discrimination of ballistic missiles. As technology matures and as lessons are learned from previous development spirals, capabilities will increase. A family of land- and sea-based radars will also be included in the invisioned layered sensor network.

## ***C2BMC***

The BMDS requires an advanced and highly complex command and control element to effectively integrate system segments and execute battle management functions. The Command, Control, Battle Management and Communications (C2BMC) architecture is designed to accept enhanced capabilities as they are integrated into the BMDS, to achieve full interoperability of the system elements and interfaces with external systems and integrate the system with the national military command structure.